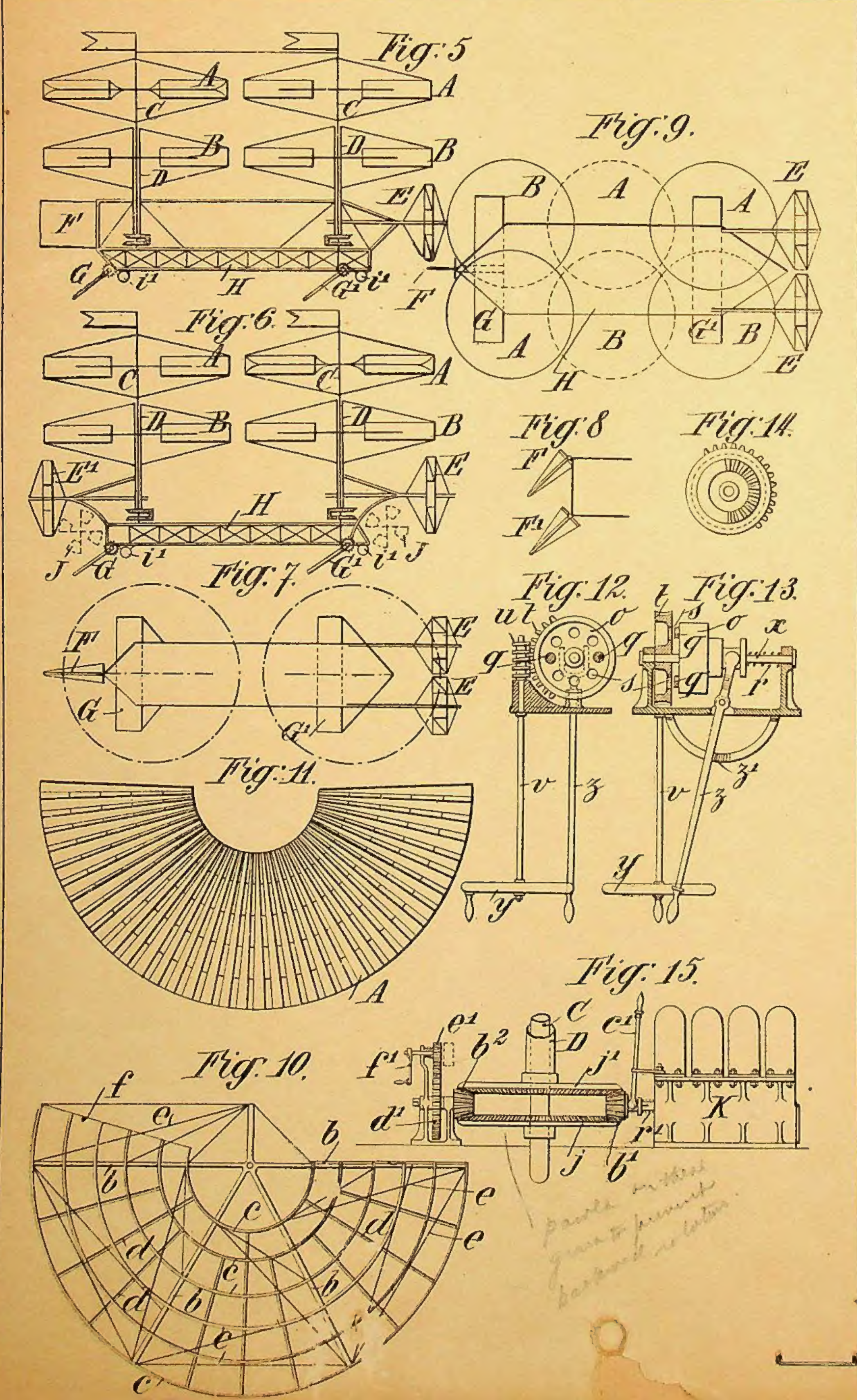
French pat 321,578

A.D. 1902. May 21. N° 11,616.

DE LIPKOWSKI'S PROVISIONAL SPECIFICATION.

(3 SHEETS)
SHEET 3.



pawls on these gears to prevent backward rotation

[This Drawing is a reproduction of the Original on a reduced scale.]

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A. N.

N° 11,616 A.D. 1902

DUPLICATE

Date of Application, 21st May, 1902

Complete Specification Left, 19th Feb., 1903—Accepted, 23rd Apr., 1903

PROVISIONAL SPECIFICATION.

"Improvements relating to Aërial Machines."

I, JOSEPH DE LIPKOWSKI, of 104 Boulevard de Courcelles Paris, in the Republic or France, Engineer, do hereby declare the nature of this invention to be as follows:—

The air ship which forms the subject of this invention consists essentially of two screws of special form and construction mounted upon two vertical concentric shafts, of a horizontal propelling screw, of a horizontal rudder, and finally of a framework in the form of a conical prism which supports the motors, the transmission and steering mechanism and the aeronauts.

In order that my invention may be readily and clearly understood, I will now describe my improved air ship with reference to the acompanying drawing, in which;

Fig. 1 is an internal elevation of my air ship

Fig. 2 is a horizontal section taken on the line 2—2 of Fig. 1.

Fig. 3 is a vertical section through the air ship shewing several modifications in the arrangement of the parts.

Fig. 4 is a horizontal section taken on the line 4—4 of Fig. 3.

Figs. 5, 6, 7, 8 and 9 shew the principal arrangements which I adopt for powerful air ships; that is to say two four or six pairs of lifting screws. In any event there are two horizontal rudders, one in front and the other at the rear.

Figs. 10 and 11 shew in detail the construction of the lifting screws.

Figs. 12, 13, and 14 shew the rudder mechanism in detail.

Fig. 15 is a detail view of the transmission mechanism.

The air ship represented in Figs. 1, 2 and 3 comprises, generally speaking, two lifting screws A and B mounted upon concentric vertical shafts C and D, a horizontal propeller E, a vertical rudder F, a horizontal rudder G and a framework platform H for the support of the motors, the transmission mechanism and the aeronauts.

Each of the screws A and B presents a helicoidal surface the generating line of which is constantly perpendicular to the axis of rotation.

The pitch of the helix, which is relatively small, corresponds to the angle of attack which in theory ensures the maximum efficiency.

Each screw is strengthened by means of a series of steel wires a a^1 which connect the principal points of the framework of the screw to the shaft of rotation. The wires a at the lower part support the whole tractive effort, whilst the upper wires a^1 support the weight of the screw when the apparatus is at rest and prevent its deformation when coming to earth.

The screw itself need not be capable of resisting torsional efforts.

In order to diminish the height of the air ship and increase its efficiency, each screw may be divided into two, four or six equal parts or elements, the summits of which should be situated in the same plane. The lowest points should also occupy the same plane.

[*Price* 8*d*.]

The different portions of each wing may be arranged step wise by fixing them upon the shaft at intervals greater than, equal to or less than the corresponding fraction of the pitch. These elements will then be in advance of, corresponding to or behind each other, that is to say the front edge of each element will be situated higher than, upon the same level as or below the rear edge of the preceding element.

The surface of each element may be continuous, that is to say entirely covered or composed of fan-like pallets, that is to say pallets directed along the radii.

The intervals separating the pallets present free spaces which facilitate the movement of the air.

Fig. 11 represents an element of this character forming a semi-spiral. In this case it is necessary that the pallets shall be rigid and strong whilst at the same time being very thin.

Fig. 10 is a plan view of the framework of an elment having a continuous surface, forming a semi-spiral.

This framework consists of four radii *b* rigidly attached to the shaft and fixed in a helicoidal plane of the pitch selected.

Upon these radii *b* are fixed rods *c* of wood or sheet aluminium, curved in the arc of a circle and inclined in accordance with the helicoidal surface (Fig. 10). These rods or ribs, which present the contour of the radii of a circular staircase, are supported at suitable intervals by stays *d*, of wood or aluminium, directed along the radii.

The whole constituted by this framework is consolidated and rendered rigid by steel wires *e* as shewn in Fig. 10.

At the front portion of the element the ribs are prolonged about one twenty fourth of a complete convolution and formed conically into blades *f*. It is the upper edge of the ribs which is shaped whilst the lower edge preserve the helicoidal surface. This blade *f* is intended to cut the air.

The framework thus constituted is covered upon both sides with balloon silk fabric, the fabric upon the lower surface is somewhat stronger than that which covers the upper part of the wing, as it is this side which supports the effective pressure of the air.

This fabric, sufficiently stretched, bears only upon the ribs of the framework. The transverse stays *d* are hollowed slightly between the ribs in order that the fabric may not touch them, even after having experienced flexion owing to the pressure of the air.

Owing to this arrangement, the fabric is able to give between the ribs; it then assumes a concave surface, but with respect to the direction of rotation, and consequently with respect to the air, it will always maintain the same inclination. The angle of attack cannot therefore vary.

Stretching of the fabric is provided for; for this purpose, the outer rib may be displaced from the centre by means of nuts or wedges arranged upon the extremity of the radii and of the stays.

For wings having rigid pallets, such as that indicated in Fig. 11, this precaution is unnecessary.

The upper surface of the wing is covered by a light silk fabric and it presents a thoroughly smooth surface which offers no resistance to displacement.

The blade *f* of the element (Fig. 10) may be covered upon both sides by sheets of aluminium; thereby permitting its edge to be made very sharp.

The outer edges of the wings form blades so as to diminsh the resistance of the air during the lateral translation of the apparatus; a strip of sheet aluminium bent into a sharp **V** is fixed upon the whole length of the outer rib of the wing.

Each of the screws A and B (Figs. 1 and 3) is constituted by two wings composed as shewn in Fig. 10. For the screw A the thread is right handed, whilst the screw B is a left handed screw.

By reducing the dimensions of the elements, each screw may be composed not of two, but of four, six, eight or more wings, each provided with its blade *f*.

The lateral displacement of the air ship is assured by means of the screw E arranged at the front of the apparatus, and steering is effected by means of the rudder F.

The propeller E has two, three or four wings and its pitch is sufficiently large to permit of high speeds of translation.

Rotation and change of velocity are assured by means of two differential cones g and g^1 which carry a crossed belt h permitting of the employment of cones having straight generating lines.

The driving pulley g may be arranged directly upon the shaft of the motor I (Fig. 3) or upon an intermediate platform H^1 (Fig. 1). In either case loose pulleys are provided so as to permit the motor to be started without driving the screw, or so as to stop the rotation of the screw without stopping the motor.

The employment of transmission pulleys permits of varying the velocity of rotation from the simple to the quadruple in passing through all the intermediate degrees. It is only necessary in order to effect this to turn the crank i which displaces the forks k and k^1, that is to say the belt, in the desired direction (Figs. 1 and 3).

The rigidity of the forks k and k^1, and the fact that it is impossible that they should become displaced without the help of the crank u, ensures complete uniformity in the velocity selected. The shaft 1 of the propeller E turns in ball bearings.

The wings of the propeller E are strengthened by means of steel wires m which transmit to the shaft the tractive effort developed by the screw.

What has been stated with respect to the propeller screw E is equally applicable to cases in which two screws instead of one are employed (Figs. 6, 7 and 9).

The vertical rudder F consists of a frame covered with fabric; as far as possible it is arranged in such a manner that its centre may be at the same level as the axis of the propeller screw E. The peculiarity of this rudder consists in the fact that it may be instantly rendered free. Under these conditions it is able to pivot freely upon its vertical axis n.

The device by means of which this is effected is shewn in Figures 12, 13 and 14; it consists of a drum o rotatable upon a shaft x. Upon this drum is wound the endless cable p coming from another drum or pulley o^1 fixed upon the vertical shaft n of the rudder. This cable p passes twice round each of the drums o o^1 and is fixed in such a manner that it is not able to slip.

The drum o carries two or four gudgeons or cylindrical nipples q which under the action of a spring r enter holes s formed in a pinion t which is loose upon the shaft x.

This pinion t is able to rotate in either direction owing to the fact that the shaft v terminates in an endless screw u.

A crank y, capable of being rotated in either direction, permits of turning in the corresponding direction the pinion t, the drum o and consequently the rudder F. This movement being ensured by the endless screw u there is no danger that the pressure of the wind upon the rudder will cause it to return when the crank y is released.

In order to instantly release the rudder F it is only necessary to displace towards the left hand the engaging lever z which the notch z^1 of a sector (Figure 13) locks in this new position.

The fork in which the lever z terminates then presses to the right hand the drum o in compressing the spring r; the pins q leave the pinion t and the drum o is released, thus permitting the rudder F to move freely and to no longer present any resistance to the wind.

In order to again fix the rudder, it is only necessary to cause the lever z to leave the stop notch z^1, when the spring r will press back to the left hand the drum o and will again render it rigid with the pinion t.

Instead of the pins q and holes s there may be formed upon the lateral cheeks

of the pinion t and of the drum o (see Figure 14) flat circular teeth which fit one within the other.

It may be advantageous, in the case of air ships of which the car is of considerable width, to provide two coupled rudders F and F^1 as shewn in Figure 8.

The rudder having a plane surface may be replaced by one or two transverse screws J mounted upon a horizontal shaft (shewn in dotted lines in Figures 1 and 6). By causing this screw to rotate in one direction or the other, the air ship may be readily caused to turn upon its own vertical axis, that is to say without starting the propeller screw F.

The horizontal rudder G (Figures 1, 2, 3, 4, 5, 6, 7, 8 and 9) plays an exceedingly important part during the horizontal displacement of the air ship. It is this rudder which ensures stability and maintains the shafts C and D carrying the lifting screws A and B vertical.

When the air ship rises under the action of the lifting screws, equilibrium is ensured by the weight of the system as a whole, the centre of gravity of which is situated below the screws.

But during lateral displacement, under the influence of the propeller E F, the resistance of the wind upon the screws A and B is greater than its pressure upon the car or platform H which in addition is arranged much nearer to the propeller shaft than the lifting screws.

It follows from this that the air ship is no longer in equilibrium and that the resistance of the air tends to incline the tops of the shafts C and D towards the rear.

This inclination would be prejudicial and would automatically increase because the surface presented to the air by the lifting screws A and B would increase with the inclination of their shaft.

In order to obviate this defect the horizontal rudder G arranged at the lower part of the car is made use of.

This rudder consists of a rigid frame covered by a strong silk fabric.

During the ascension of the air ship, or on coming to ground, this rudder is released, and the springs r^1 (Figure 1) automatically bring it back to a horizontal position.

The mechanism for steering and for releasing this rudder G is identical with that of the vertical rudder F, but it may be mounted in two different manners: 1st. The axis of the rudder coincides with the axis of the steering apparatus of which it constitutes a prolongation. In this case the drum o (Figures 12 and 13) is able to slide but not to rotate upon the shaft, and this drum is reduced to a plate adapted to engage with the pinion t as above stated; 2nd. the rudder shaft is distinct and is then parallel with the axis of the steering mechanism. The drum o is then replaced by a toothed pinion which gears with a toothed wheel fixed upon the rudder shaft.

As regards the steering mechanism itself, it is identical with that of the vertical rudder.

When the air ship, after having reached the desired height, begins its horizontal displacement under the tractive effort imparted to it by the propeller, the aeronaut turns the crank y^1 (Figures 1, 3 and 4) and inclines to a greater or less extent the horizontal rudder G so that the resistance which this rudder offers to the wind compensates for the action of the wind upon the lifting screws A and B. In this manner perfect equilibrium may be obtained, that is to say the main axis of the apparatus may be rendered vertical whatever may be the velocity of translation.

The horizontal rudder G is then inclined in a direction such that the effort exerted upon it by the wind tends to raise the air ship as a whole, thereby relieving the lifting screws A and B.

For air ships provided with two horizontal rudders G and G^1 (Figures 5, 6, 7, and 9) the whole system may be inclined in one direction or the other, merely by actuating the front rudder G^1 or the rear rudder G.

Upon coming to earth, the horizontal rudders are instantly released, and the counter springs cause them to resume their normal position.

The most simple form of transmission is that shewn in Figure 3, the details of which are represented in Figure 15.

The two concentric vertical shafts C and D are provided at their lower extremity with two bevelled gear wheels j and j^1 which mesh directly with the pinion b^1 mounted upon the shaft of the principal motor K in such a manner that the two shafts rotate in opposite directions.

The pinion b^1 is able to slide upon the shaft of the motor K and in order to isolate the motor it is only necessary to bear upon a lever c^1, the fork in which this lever terminates pressed to the right hand the driving pinion in such a manner as to effect disengagement.

In order to again couple up the motor, the lever c^1 is released and the spring r^2 presses the pinion b^1 to the left hand.

As the pinion b^1 is intended to gear with the two toothed wheels j and j^1, the teeth of these latter must be presented simultaneously, and for this reason there is provided upon the left hand side a guide pinion b^2 which equalises the angular displacement of the two toothed wheels.

The shaft of this guide pinion b^2 is prolonged and carries a toothed wheel d^1 meshing with a pinion e^1 the shaft of which carries a crank f^1. This arrangement permits of utilising the guide pinion b^2 for starting, by hand, the two vertical screws A and B and in this manner to facilitate getting the air ship under way.

Upon releasing the crank f^1 the spring r^3 presses the pinion e^1 into the position indicated in dotted lines in Figure 15 and disengagement takes place automatically; the wheel d^1 is then able to rotate without the crank f^1 being caused to participate in this movement of rotation. Upon the toothed wheels j and j^1 retaining pawls are caused to act which only permit of the rotation of the shafts C and D in one direction, one to the right and the other to the left hand.

The motor K may also be thrown out of gear in the following manner:

The pinion b^1 is loose upon the shaft, and it remains permanently in contact with the bevel wheels j and j^1. Within this pinion fits, upon that side adjacent to the motor, a friction cone displaced by the lever c^1 and spring r^2.

In this case engagement is effected by means of the friction cone.

In order to deaden the shock which might take place if the air ship came to ground with any considerable velocity, there are provided beneath the car three, four or even more grounding buffers i^1, according to the form and dimensions of the car.

These buffers consist of an envelope of very strong rubbered fabric manufactured in the same manner as motor car tyres.

Air is compressed within this envelope by means of a motor car pump.

The spherical buffers shewn may be replaced by buffers traversed by an axle in such a manner as to constitute a wheel. These buffer wheels may be utilised for the displacement of the air ship when resting upon the ground.

As regards the lifting screws, it will be readily understood that they may be combined in pairs to a greater or less number as indicated in Figures 5, 6, 7 and 9.

Figure 5 shews an air ship having two pairs of lifting screws A and B.

Figure 6 shews an air ship which is also provided with two pairs of lifting screws A and B, but in which there are two propeller screws E and E^1, one in the front and the other in the rear, and in which the rudder F is replaced by two small screws mounted upon horizontal shafts, arranged at right angles to the longitudinal axis of the apparatus, one in the front and one behind, these screws rotating in opposite directions and being capable of changing their direction of rotation, thereby permitting of steering the air ship in any direction without running the propeller screws. The arrangement shewn in Figure 7 may be employed for the simple airship represented in Figure 1 by replacing the rudder F by a horizontal screw, as shewn in dotted lines in the said figure

Instead of arranging one of the propeller screws in front and one at the rear, as shewn in Figure 6, both propellers may be placed in the front, as shown in Figures 7 and 9. The framework of the air ship is then of greater width and in such cases it may be advantageous to replace the central rudder by two coupled rudders attached behind the framework and upon both sides of the same, as shewn in Figure 8.

Figure 9 represents an exceedingly powerful air ship comprising four (or even six) pairs of conjugated lifting screws. In this case the screws are not arranged at the same level; they overlap in order to economise space.

In any event each pair of lifting screws consists of two screws A and B, one to the right and the other to the left hand and rotating in opposite directions, in order to nullify the giratory effort which the motor might produce upon the car. In all cases also the two shafts C and D are concentric being composed of steel tubes and all the bearings are ball bearings, as shewn in Figure 3.

Dated this 21st day of May 1902.

HASELTINE, LAKE & Co.,
45 Southampton Buildings, London, W.C.,
Agents for the Applicant.

COMPLETE SPECIFICATION.

"Improvements relating to Aërial Machines"

I, JOSEPH DE LIPKOWSKI, of 104 Boulevard de Courcelles Paris, in the Republic of France, Engineer, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention consists of an air-ship the essential feature of which is two screws of special form and construction mounted upon two vertical concentric shafts, of a horizontal propelling screw, of a horizontal rudder, and finally of a framework in the form of a conical prism which supports the motors, the transmission and steering mechanism and the aeronauts.

In order that my invention may be readily and clearly understood, I will now describe my improved air ship with reference to the accompanying drawings, in which:

Fig. 1 is an internal elevation of my air ship

Fig. 2 is a horizontal section taken on the line 2—2 of Fig. 1.

Fig. 3 is a vertical section through the air ship shewing several modifications in the arrangement of the parts.

Fig. 4 is a horizontal section taken on the line 4—4 of Fig. 3.

Figs. 5, 6, 7, 8 and 9 shew the principal arrangements which I adopt for powerful air ships; that is to say two four or six pairs of lifting screws. In any event there are two horizontal rudders, one in front and the other at the rear.

Figs. 10 and 11 shew in detail the construction of the lifting screws

Fig. 10^{bis} shews the details of one of the screws

Figs. 12, 13 and 14 shew the rudder mechanism in detail.

Fig. 15 is a detail view of the transmission mechanism.

The air ship represented in Figs. 1, 2 and 3 comprises, generally speaking, two lifting screws A and B mounted upon concentric vertical shafts C and D, a horizontal propeller E, a vertical rudder F, a horizontal rudder G and a framework platform H for the support of the motors, the transmission mechanism and the aeronauts.

Each of the screws A and B presents a helicoidal surface the generating line of which is constantly perpendicular to the axis of rotation.

The pitch of the helix, which is relatively small, corresponds to the angle of attack which in theory ensures the maximum efficiency.

Each screw is strengthened by means of a series of steel wires a a^1 which connect the principal points of the framework of the screw to the shaft rotation. The wires a at the lower part support the whole tractive effort, whilst the upper wires a^1 support the weight of the screw when the apparatus is at rest and prevent its deformation when coming to earth.

The screw itself need not be capable of resisting torsional efforts.

In order to diminish the height of the air ship and increase its efficiency, each screw may be divided into two, four or six equal parts or elements, the summits of which should be situated in the same plane. The lower points should also occupy the same plane.

The different portions of each wing may be arranged step wise by fixing them upon the shaft at intervals greater than, equal to or less than the corresponding fraction of the pitch. These elements will then be in advance of, corresponding to or behind each other, that is to say the front edge of each element will be situated higher than, upon the same level as or below the rear edge of the preceding element.

The surface of each element may be continuous, that is to say entirely covered or composed of fan-like pallets, that is to say pallets directed along the radii.

The intervals separating the pallets present free spaces which facilitate the movement of the air.

Fig. 11 represents an element of this character forming a semi-spiral. In this case it is necessary that the pallets shall be rigid and strong whilst at the same time being very thin.

Fig. 10 is a plan view of the framework of an element having a continuous surface, forming a semi-spiral.

This framework consists of four radii b rigidly attached to the shaft and fixed in a helicoidal plane of the pitch selected.

Upon these radii b are fixed concentric ribs c of wood curved in the arc of a circle and inclined in accordance with the helicoidal surface (Figs. 10 and 10^a). These rods or ribs, which present the contour of the rail of a circular staircase, are supported at suitable intervals by stays d, of steel tubing directed along the radii.

The whole constituted by this framework is consolidated and rendered rigid by steel wires e as shewn in Fig. 10 and 10^a.

At the front portion of the element the concentric wooden ribs are prolonged about one twenty fourth of a complete convolution and formed conically into blades f. It is the upper edge of the ribs which is shaped whilst the lower edge preserves the helicoidal surface. This blade f is intended to cut the air.

The framework thus constituted is covered upon both sides with balloon silk fabric, the fabric upon the lower surface is somewhat stronger than that which covers the upper part of the wing, as it is this side which supports the effective pressure of the air.

This fabric, sufficiently stretched, bears only upon the ribs of the framework. The transverse stays d are arranged at a sufficient height in order that the fabric may not touch them, even after having experienced flexion owing to the pressure of the air.

Owing to this arrangement, the fabric is able to give between the ribs; it then assumes a concave surface, but with respect to the direction of rotation, and consequently with respect to the air, it will always maintain the same inclination.

The angle of attack cannot therefore vary.

Stretching of the fabric is provided for; for this purpose, the outer rib may be displaced from the centre by means of nuts or wedges arranged upon the extremity of the radii and of the stays.

For wings having rigid pallets, such as that indicated in Fig. 11, this precaution is unnecessary.

The upper surface of the wing is covered by a light silk fabric and it presents a thoroughly smooth surface which offers no resistance to displacement.

The blade *f* of the element (Fig. 10) may be covered upon both sides by sheets of aluminium, thereby permitting its edge to be made very sharp.

The outer edges of the wings form blades so as to diminish the resistance of the air during the lateral translation of the apparatus; a strip of sheet aluminium bent into a sharp **V** is fixed upon the whole length of the outer rib of the wing.

Each of the screws A and B (Figs. 1 and 3) is constituted by two wings composed as shewn in Fig. 10. For the screw A the thread is right handed, whilst the screw B is a left handed screw.

By reducing the dimensions of the elements, each screw may be composed not of two, but of four, six, eight or more wings, each provided with its blade *f*.

The lateral displacement of the air ship is assured by means of the screw E arranged at the front of the apparatus, and steering is effected by means of the rudder F.

The propeller E has two, three or four wings and its pitch is sufficiently large to permit of high speeds of translation.

Rotation and change of velocity are assured by means of two differential cones *g* and g^1 which carry a crossed belt *h* permitting of the employment of cones having straight generating lines.

The driving pulley *g* may be arranged directly upon the shaft of the motor I (Fig. 3) or upon an intermediate platform H^1 (Fig. 1). In either case loose pulleys are provided so as to permit the motor to be started without driving the screw, or so as to stop the rotation of the screw without stopping the motor.

The employment of transmission pulleys permits of varying the velocity of rotation from the simple to the quadruple in passing through all the intermediate degrees. It is only necessary in order to effect this to turn the crank *i* which displaces the forks *k* and k^1, that is to say the belt, in the desired direction (Figs. 1 and 3).

The rigidity of the forks *k* and k^1, and the fact that it is impossible that they should become displaced without the help of the crank *i*, ensures complete uniformity in the velocity selected. The shaft *l* of the propeller E turns in ball bearings.

The wings of the propeller E are strengthened by means of steel wires *m* which transmit to the shaft the tractive effort developed by the screw.

What has been stated with respect to the propeller screw E is equally applicable to cases in which two screws instead of one are employed (Figs. 6, 7 and 9).

The vertical rudder F consists of a frame covered with fabric; as far as possible it is arranged in such a manner that its centre may be at the same level as the axis of the propeller screw E. The peculiarity of this rudder consists in the fact that it may be instantly rendered free. Under these conditions it is able, to pivot freely upon its vertical axis *n*.

The device by means of which this is effected is shewn in Figs. 12, 13 and 14; it consists of a drum *o* rotatable upon a shaft *x*. Upon this drum is wound the endless cable *p* coming from another drum or pulley o^1 fixed upon the vertical shaft *n* of the rudder. This cable *p* passes twice round each of the druns *o* o^1 and is fixed in such a manner that it is not able to slip.

The drum *o* carries two or four gudgeons or cylindrical nipples *q* which under the action of a spring *r* enter holes *s* formed in a pinion *t* which is loose upon the shaft *x*.

This pinion *t* is able to rotate in either direction owing to the fact that the shaft *v* terminates in an endless screw *u*.

A crank *y*, capable of being rotated in either direction, permits of turning in the corresponding direction the pinion *t*, the drum *o* and consequently the

rudder F. This movement being ensured by the endless screw u there is no danger that the pressure of the wind upon the rudder will cause it to return when the crank y is released.

In order to instantly release the rudder F it is only necessary to displace towards the left hand the engaging lever z which the notch z^1 of a sector (Fig. 13) locks in this new position.

The fork in which the lever z terminates then presses to the right hand the drum o in compressing the spring r; the pins q leave the pinion t and the drum o is released, thus permitting the rudder F to move freely and to no longer present any resistance to the wind.

In order to again fix the rudder, it is only necessary to cause the lever z to leave the stop notch z^1, when the spring r will press back to the left hand the drum o and will again render it rigid with the pinion t.

Instead of the pins q and holes s there may be formed upon the lateral cheeks of the pinion t and of the drum o (see Figure 14) flat circular teeth which fit one within the other.

It may be advantageous, in the case of air ships of which the car is of considerable width, to provide two coupled rudders F and F^1 as shewn in Figure 8.

The rudder having a plane surface may be replaced by one or two transverse screws J mounted upon a horizontal shaft (shewn in dotted lines in Figures 1 and 6). By causing this screw to rotate in one direction or the other, the air ship may be readily caused to turn upon its own vertical axis, that is to say without starting the propeller screw F.

The horizontal rudder G (Figures 1, 2, 3, 4, 5, 6, 7, 8 and 9) plays an exceedingly important part during the horizontal displacement of the air ship. It is this rudder which ensures stability and maintains the shafts C and D carrying the lifting screws A and B vertical.

When the air ship rises under the action of the lifting screws, equilibrium is ensured by the weight of the system as a whole, the centre of gravity of which is situated below the screws.

But during lateral displacement, under the influence of the propeller F, the resistance of the wind upon the screws A and B is greater than its pressure upon the car or platform H which in addition is arranged much nearer to the propeller shaft than the lifting screws.

It follows from this that the air ship is no longer in equilibrium and that the resistance of the air tends to incline the tops of the shafts C and D towards the rear.

This inclination would be prejudicial and would automatically increase because the surface presented to the air by the lifting screws A and B would increase with the inclination of their shaft.

In order to obviate this defect the horizontal rudder G arranged at the lower part of the car is made use of.

This rudder consists of a rigid frame covered by a strong silk fabric.

During the ascension of the air ship, or on coming to ground, this rudder is released, and the springs r^1 (Figure 1) automatically bring it back to a horizontal position.

The mechanism for steering and for releasing this rudder G is identical with that of the vertical rudder F, but it may be mounted in two different manners: 1st. The axis of the rudder coincides with the axis of the steering apparatus of which it constitutes a prolongation. In this case the drum o (Figures 12 and 13) is able to slide but not to rotate upon the shaft, and this drum is reduced to a plate adapted to engage with the pinion t as above stated; 2nd, the rudder shaft is distinct and is then parallel with the axis of the steering mechanism. The drum o is then replaced by a toothed pinion which gears with a toothed wheel fixed upon the rudder shaft.

As regards the steering mechanism itself, it is identical with that of the vertical rudder.

When the air ship, after having reached the desired height, begins its horizontal displacement under the tractive effort imparted to it by the propeller, the aeronaut turns the crank y^1 (Figures 1, 3 and 4) and inclines to a greater or less extent the horizontal rudder G so that the resistance which this rudder offers to the wind compensates for the action of the wind upon the lifting screws A and B. In this manner perfect equilibrium may be obtained, that is to say the main axis of the apparatus may be rendered vertical whatever may be the velocity of translation.

The horizontal rudder G is then inclined in a direction such that the effort exerted upon it by the wind tends to raise the air ship as a whole, thereby relieving the lifting screws A and B.

For air ships provided with two horizontal rudders G and G^1 (Figures 5, 6, 7 and 9) the whole system may be inclined in one direction or the other, merely by actuating the front rudder G^1 or the rear rudder G.

Upon coming to earth, the horizontal rudders are instantly released, and the counter springs cause them to resume their normal position.

The most simple form of transmission is that shewn in Figure 3, the details of which are represented in Figure 15.

The two concentric vertical shafts C and D are provided at their lower extremity with two bevelled gear wheels j and j^1 which mesh directly with the pinion b^1 mounted upon the shaft of the principal motor K in such a manner that the two shafts rotate in opposite directions.

The pinion b^1 is able to slide upon the shaft of the motor K and in order to isolate the motor it is only necessary to bear upon a lever c^1 the fork in which this lever terminates presses to the right hand the driving pinion in such a manner as to effect disengagement.

In order to again couple up the motor, the lever c^1 is released and the spring r^2 presses the pinion b^1 to the left hand.

As the pinion b^1 is intended to gear with the two toothed wheels j and j^1, the teeth of these latter must be presented simultaneously, and for this reason there is provided upon the left hand side a guide pinion b^2 which equalises the angular displacement of the two toothed wheels.

The shaft of this guide pinion b^2 is prolonged and carries a toothed wheel d^1 meshing with a pinion e^1 the shaft of which carries a crank f^1. This arrangement permits of utilising the guide pinion b^2 for starting, by hand, the two vertical screws A and B and in this manner to facilitate getting the air ship under way.

Upon releasing the crank f^1 the spring r^3 presses the pinion e^1 into the position indicated in dotted lines in Figure 15 and disengagement takes place automatically; the wheel d^1 is then able to rotate without the crank f^1 being caused to participate in this movement of rotation. Upon the toothed wheels j and j^1 retaining pawls are caused to act which only permit of the rotation of the shafts C and D in one direction, one to the right and the other to the left hand.

The motor K may also be thrown out of gear in the following manner:

The pinion b^1 is loose upon the shaft, and it remains permanently in contact with the bevel wheels j and j^1. Within this pinion fits, upon that side adjacent to the motor, a friction cone displaced by the lever c^1 and spring r^2.

In this case engagement is effected by means of the friction cone.

In order to deaden the shock which might take place if the air ship came to ground with any considerable velocity, there are provided beneath the car three, four or even more grounding buffers i^1, according to the form and dimensions of the car.

These buffers consist of an envelope of very strong rubbered fabric manufactured in the same manner as motor car tyres.

Air is compressed within this envelope by means of motor car pump.

The spherical buffers shewn may be replaced by buffer wheels. These buffer-wheels may be utilised for the displacement of the air ship when resting upon the ground.

As regards the lifting screws, it will be readily understood that they may be combined in pairs to a greater or less number as indicated in Figures 5, 6, 7 and 9.

Figure 5 shews an air ship having two pairs of lifting screws A and B.

Figure 6 shews an air ship which is also provided with two pairs of lifting screws A and B, but in which there are two propeller screws E and E^1, one in the front and the other in the rear, and in which the rudder F is replaced by two small screws J mounted upon horizontal shafts, arranged at right angles to the longitudinal axis of the apparatus, one in the front and one behind, these screws rotating in opposite directions and being capable of changing their direction of rotation, thereby permitting of steering the air ship in any direction without running the propeller screws. The arrangement shewn in Figure 7 may be employed for the simple air ship represented in Figure 1 by replacing the rudder F by a horizontal screw, as shewn in dotted lines in Figure 1.

Instead of arranging one of the propeller screws in front and one at the rear, as shewn, in Figure 6, both propellers may be placed in the front, as shewn in Figures 7 and 9. The framework of the air ship is then of greater width and in such cases it may be advantageous to replace the central rudder by two coupled rudders attached behind the framework and upon both sides of the same, as shewn in Figure 8.

Figure 9 represents an exceedingly powerful air ship comprising four (or even six) pairs of conjugated lifting screws. In this case the screws are not arranged at the same level; they overlap in order to economise space.

In any event each pair of lifting screws consists of two screws A and B, one to the right and the other to the left hand and rotating in opposite directions, in order to nullify the giratory effort which the motor might produce upon the car. In all cases also the two shafts C and D are concentric being composed of steel tubes and all the bearings are ball bearings, as shewn in Figure 3.

Having now particularly described and ascertained the nature of my said invention, and in what manner the same is to be performed, I declare that what I claim is:—

1. In an air ship, the arrangement of lifting screws mounted upon vertical shafts above the platform or car and each composed of a helicoidal wing or helicoidal wings of small pitch, each wing being constituted by a rigid framework of a material such as wood or aluminium covered upon both sides with a balloon-silk fabric, the fabric upon the under side being adapted to yield between the ribs of the framework without the angle of inclination of its surface with respect to the movement of the wing being capable of varying, as above specified.

2. In an air ship the lifting screws mounted upon vertical shafts above the platform or car each screw being composed of a strong framework upon which are fixed, fanwise, thin pallets of wood, ebonite or toughened paper, the front of each of these pallets being cut or formed as a blade so as to readily cut the air, as above specified.

3. In an air ship, the arrangement, beneath the platform or car of a horizontal rudder serving to ensure the equilibrium and uprightness of the apparatus during its movement of translation.

4. In an air ship, the mechanism for operating and releasing the rudders for steering and ensuring stability, as described with reference to Figs. 12, 13 and 14.

5. In an air ship, the special provision, at the rear of the car or platform of two vertical steering rudders coupled, arranged, operated and acting in the manner and for the purpose indicated having regard to Fig. 8.

6. In an air ship, the provision of two rudders for ensuring stability and uprightness, one arranged at the front and the other at the rear of the framework, the said rudders being actuated and rendered operative in the manner and for the purpose specified.

7. In an air ship, the arrangement of lifting screws mounted upon concentric

vertical shafts in combination with operating, engaging and starting mechanism, interposed between the said shafts and the motor, as specified with reference to Fig. 15.

8. In an air ship, the provision of lifting screws mounted upon concentric vertical shafts driven in such a manner as to rotate in opposite directions, and acting in combination with ball bearings, as specified with reference to Fig. 3.

9. In an air ship, the provision beneath the car or platform of hollow buffers in the form of spheres or wheels, the said buffers being inflated with air and serving to deaden the shock upon the apparatus coming to ground, and in addition, when they present the form of wheels (in which case they are mounted upon axles) for the displacement of the apparatus upon the ground, as above specified.

10. In an air ship, provided with propeller screws the disposition permitting of changing the speed of rotation by the employment of two cones and of guides; the whole operating in the manner and for the purpose specified with respect to Figs. 1 and 3.

11. In an air ship the arrangement of two propellers arranged in front of their platform or car, as specified with reference to Figs. 7 and 9.

12. An air ship characterized by the fact that it has a car or platform carrying the motors, transmission mechanism and the aeronauts; lifting screws mounted upon vertical shafts above the said platform and acting in pairs, the members of each pair being arranged to rotate in opposite directions; a horizontal propeller screw arranged in front of the said platform; a vertical rudder for steering the air ship and arranged at the rear of the said platform; and a horizontal rudder installed beneath the said platform and serving to ensure the stability and the uprightness of the air ship; the whole arranged combined and operating in the manner and for the purpose specified.

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